A CORPORATE MODEL OF SIMILITUDE FOR SMEs REUNION INTO A CORPORATION, VIEWED FROM THE ANGLE OF PHYSICAL THOUGHT, AND ITS COMPLEX ECONOMIC AND SOCIAL IMPACT

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Abstract
In order to exceed the circularity of formal economic thinking, the authors of the present paper favour the models of thinking specific to physics, which are also constructed statistically and mathematically, in an attempt to find an answer to the reunion of similar small and medium enterprises (SMEs), into multinational corporations. A model based on the theory of similitude is thus made use of, born from the very essence of physics, and having an economic and social destination and a complex impact. The physical models intended for economic systems are expressed as systems of partial differential equations, and the result becomes a new vision of reality. This paper details an original model based on physical similitude for SME amalgamation under the name of multinational corporations. After an introduction to the physical theory of similitude, the first section describes the physics model because of the reunion of similar SMEs. The real birth of some corporations in Serbia forms the content of the second section; the economic and social phenomena relating to the generation of such corporations, and the corporate social responsibility are emphasized. The idea of social complexity and its impact as the fifth dimension of a modern multinational corporation conclude the paper.

Keywords: physical model, small and medium enterprise (SME), multinational corporation (MNE), corporate social responsibility (CSR), economic and social complexity

JEL Classification: C65, M10, M13, M14

Introduction

The mental model represents our understanding of a portion of the reality that we have profoundly become aware of, or methodically known. Any mental or thinking model must be flexible, in the sense that it should reconsider the reality that is being studied or synthesized as a domain of information extended beyond the numerically limited universe, or in different words, beyond the simple mathematical model, thus becoming a filter through which reality may be interpreted, so that rational action may be exerted on it; more

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specifically, one could select, in a well-grounded manner and according to an optimal prognosis, the solution or variant for action best suited to the respective situation. In a certain sense, logical, philosophical, mathematical, physical, economic, etc. thought can be identified and redefined, in turn, through the mental models of certain sciences.

There are disadvantages of a general character inherent to virtually all the mental models (from the difficulty of comprehending them, to the subjectivity of their interpretation, from their imperfection as a methodology, to their lack of completion in point of covering reality, etc.), and also specific disadvantages (such as appears to be the *name* as an instrument usable to know the permanent and invariable essence of things in the linguistic model, or minimality and non-contradictoriality in the logical model, etc.). Gödel's problem, or the problem of the circularity of the formal systems, which has since become famous, found that the hope of expressing knowledge in a formal manner was illusory, and that there were, in the main formal logical systems, or in the related systems, relatively simple assertions or theorems, which could not be solved within the system in question, as the respective assertions or theorems in the model analyzed were neither demonstrable, nor non-demonstrable. Economics has, on numberless occasions, revealed the fracture existing between truth, in the sense of reality, and truth validation, in the acceptation of methodological and theoretical fitting into the formal systems (synthesized mathematically or linguistically), through which an attempt was continuously made to explain the evolution of a number of apparently simple phenomena like the appearance of price, inflation and its derivatives, profit or non-profit, recession or economic growth, etc. We understand by a mathematical model a manner of expressing, by means of mathematical symbols, and using mathematical concepts, the relationships that are instituted among the variables and the parameters specific to a portion of the reality under research. The mathematical models provide a series of advantages compared to the linguistic ones; the former set is more explicit from an objective standpoint, and their hypotheses are communicated and become criticizable, apt to validation or demonstrable, while the consequences of these models and their presuppositions have a justification obtained through a mathematical reasoning of a comprehensive and multi-factorial logical type, in a general manner. The mathematical model is worded symmetrically, in a balanced and homogeneous manner, centred on the principle of natural conservation. In other words, there are certain quantitative variables (the origin of the coordinates for the time or space) which depend on absolutely nothing in the mathematical model. These aspects permit their access to abstract domains, where only logical reasoning functions, with no influence of the economic, social or physical signification of the variables and parameters specific to those representations. The laws of conservation provide the foundation of the mathematical models. That is the factor, which secures their completeness and minimality, being protected from the danger of circularity, where the words are rectified. However, it is easy to find that the forte of the mathematical mental model, i.e. the abstract domain which they manipulate, very rarely appears, or is non-existent in the surrounding reality, and the domains frequently identified in nature (be it economic, social or human) do not allow of that type of introspection. To that is added a number of objections concerning the hypotheses of the mathematical model, which are difficult to examine in real practice, or are linked to the inter-factorial concrete relations and connections existing in the mathematical models that often appear among factors hard to quantify, or factors for which there are no numerical data. The mathematical model frequently infringes William Ockham's principle concerning the simplification of the model through limitation to as few causes, factors or variables as possible (it is also called the principle of modelling parsimony). In the economic opinion, the model remains a commonplace instrument intended to solve general problems, and modelling represents either a sequence of means of revealing the real nature of the problems of economic theory, from those of national wealth to those connected with earmarking sufficient resources, or a simplified image of the relationships between the economic variables, close to the structural-anatomical representation of the economic processes (defining the variables), and the physiological description (relationships, conditioning, operation mechanisms). The statistical model additionally reveals the stage-ordered sense of the concept of model, that is to say a link in an integrated cognitive process, which is in turn made up of a hypothesis, a schematic representation of a process (phenomenon), the statistical testing of the hypotheses formulated on the reality, and the taking over of the process in a general theory.

The econometric model, maybe the first multidisciplinary model, is constituted as an aggregation of other three models (mathematical, economic and statistical) and opens the horizon for multiple disciplinary collaborative works. In constructing the econometric model, three dominant elements from the mathematical mental or theoretical model are to note: a) the primacy of theory, through the agency of Louis Pasteur's well-known formula: "*the chance favours only the well-trained minds*"; b) the "*dogmatics of isolation*" of the model, once constructed, as compared with the initial economic reality that generated it, an element synthesized by Tiberiu Schatteles in likening it with economic modelling as a process in itself; c) defining the framework of the modelling isolation through postulates or axioms such as "*something that goes without saying*", which complete the study of a phenomenon in isolation, specific to the economic theory; d) the option for a complex iterative statistical process of modelling, either in simplified variants of the type of the "*triad*" (the formulation of a hypothesis, collecting the experimental material, and the verification of the hypothesis), or in excessively detailed variants (the formulation of the initial model through making up of classes of repartitions, culling the data, choosing a particular repartition, verification of the degree of concordance of the repartition chosen with the real situation, and formulation of the hypotheses which explain the mechanisms that have generated the data, etc.).

The authors of the present article have opted for the model of thinking specific to physics, in order to exceed the circularity of formal economic thinking, modelled in a statistical-mathematical manner, including the product of those attempts that is considered optimal, called an econometric model, which exhibits essential limitations, such as the use of a number of reductionist economic methods in some cases, the impossibility of the quantitative model to fit into one or another theory, the broad gap of the prediction errors, and even the absence from the econometric model of several explanatory variables relating to the response of the authorities and the economic policies that can sometimes distort, even on a short term, rationality in economy. The econometric model, in its modern acceptation, exhibits a continual time-degradation of the first form of the model, a fact admitted through the frequency of the statement "*in business few (cor)relations preserve through time their initial mathematical accuracy*". The success of the econometric model is not unanimously accepted among economists either, among those who should enjoy its applicability to the highest extent. Thus, Ludwig von Mises and Friedrich von Hayek, two major representatives of the neo-classical Austrian school of economics, contested the formalization, through econometric modelling, of economic behaviour, emphasising the poor balance of the predictions made starting from the econometric models over the past few decades, despite the increasingly modern calculus equipment and the ever more sophisticated models used, with increasingly graver theoretical accents, virtually missing the impact of experiment.

At the pragmatic and challenging crossroads of economics (i.e. econometric research) and sociology (sociological research), or, more recently, even of politology with physics (that is, the thought based on physical, quantum statistic, or the theory of relativity), completely new sciences have been generated over the last three decades, e.g. econophysics and sociophysics, quantum economics, etc., which vie, through their seeming originality and simplicity, with the impact of other new modern research methods that emerge and take firmer shape, such as the science of complexity, the science of the neural net systems, of the genetic algorithms, of fuzzy and neutrosophic logic. Their historical evolution is an occasion for us to acknowledge the pace of the development of the border disciplines. The physical model can contribute, through its econophysical, sociophysical, quantum-economic, etc. form, in an unexpected manner, to the understanding of the economic problems, of the processes or decisions of an economic-social type: a) by its dual methodology (of an analytical and simultaneously experimental type); b) by its solutions meant to decompose a system coherently, or very close to the reality; c) through the signification attributed to the measuring scale, or it quantitative, revealing angle, where the qualities of an economic system, or its constitutive and determining phenomena are described, without however omitting the simplicity of the physical universe, assimilable to any other universe; d) by its specific manner of perception or of making references, always in terms of parts of the universe that must be studied within the great structural hierarchy of reality: from a micro-scale to a macro-perspective, which is done through its two great extreme disciplines (nuclear physics at the sub-level of the atomic particles, and astrophysics, at the aggregate level of the cosmic and universal type), connecting a great variety of disciplines, from chemistry, molecular biology, organic biology, psychology, up to economics, political sciences and sociology, ecology, geology and climatology and, to end with, astrophysics; e) by its contribution to establishing the equations that simplify, and the methods that describe phenomena with much more accuracy and precision, as compared to any other models, phenomena such as production, market, traffic, etc.

But the most important characteristic of the experimental models remains their common origin, given by the natural laws, or the laws of the universe (from conservation to relativization). A law of nature is a scientific generalization, based on empirical experiments or observations repeated over the years, and which is accepted by the scientific community (including the laws of our human nature, i.e. the social, economic and political laws). The physics models are centred on controlled scientific experiments, which can be repeated if their validation is required. The laws of physics mathematically express the conservation of a quantity, as well as the conservation of symmetries, or the homogeneity of space and time (the space-time object). Hence the major confusion occurring between the mental model as an expression of symmetries wished or hoped for, and the experimental (especially, the physical) model, as generator of natural laws, endowed or not with a certain intellectual beauty, a certain aesthetics, which is also to note in their simplicity and mathematical laconism.

1. The physical model of similitude used for the analysis of the corporation based on the reunion of similar SMEs

The present article proposes, as an answer to the modality of making up a corporation, a model centred on the theory of similitude, a model appertaining to physics through its essence, and to economics through its destination and impact, which a border science, whose tradition goes back only a few decades, declares to be econophysical. Up to the present, most econophysical approaches have dealt with the economic problems including large data systems, such as the finance or banking markets, the stock markets, where the methods of statistical physics are applied, and this initially caused econophysics to be defined as the result of the strict application of statistics to economy and economics. In more recent years, within the general framework of econophysics, other models have been included, which are based on analogies or phenomena belonging to still other domains of physics, such as thermodynamics, electromagnetism, spectroscopy, phase transition physics, reliability theory, etc. Nicolae Georgescu-Roegen was among the first researchers to underline the similitude holding between the evolution of economic and physical or natural phenomena, generated by the laws of thermodynamics, and, more specially, by the second law, or the law of entropic growth, applied to irreversible transformations (very much like the natural or socioeconomic laws). Another Romanian researcher, Ion Spînulescu, had recourse to the physical model of the phenomenon of amplification, which seems to be the best suited to the knowledge of the process of economic development, whose signification could also be that of amplification of inputs, i.e. the resources, capital investment, productivity, etc.

A physical model applicable in knowing and anticipating the economic process of making up the corporations, is that is similitude. Modelling can be the result of the direct processing of the information obtained from the objective rules and laws of reality (in which case we have a mathematical model), or the reflection of a system – called the *original*, through a second system – called the *model*, determined by a similarity with the original. The reflection of the original system in the model system is done through the agency of a number of complex dependencies, reflected in *similitude relationships*. *Modelling though similitude* consists in extending the geometric likeness to several physical values in the field of mechanics, heat transmission, electromagnetism, etc. The model used in physics reproduces the original in nearly all its details, and that is why modelling through similitude gets closest to *isomorphous* modelling. A model is called *isomorphous* (having the same form) if the real system (the original) and the model coincide in a complete manner, element for element, and it is *homomorphous* when the model does not coincide in a complete manner, i.e. element for element. Phenomena similar in a sense or another (i.e. physical, economic, social, etc.) can be associated certain combinations of parameters called *criteria of similitude*, which have the same value. The following equations are considered, which characterize two processes (in our case, SMEs). (Table no. 1)

Table no. 1: Similar processes described by homogeneous equations

<table>
<tr><td>For the first process</td><td>For the second process</td></tr>
<tr><td>$\varphi_1 + \varphi_2 + ... + \varphi_n = \sum_1^n \varphi_j = 0$ (1)
where: $\varphi_j = f(P_1, P_2, ..., P_m)$</td><td>$\phi_1 + \phi_2 + ... + \phi_n = \sum_1^n \phi_j = 0$ (2)
where:
$\phi_j = f(R_1, R_2, ..., R_m)$</td></tr>
<tr><td colspan="2">Since φj and ϕj are not equal to zero, these equations can be transcribed in the form:</td></tr>
<tr><td>$1 + \frac{\varphi_1}{\varphi_n} + \frac{\varphi_2}{\varphi_n} + ... + \frac{\varphi_{n-1}}{\varphi_n} = \sum_1^n \frac{\varphi_j}{\varphi_n} = 0$</td><td>$1 + \frac{\phi_1}{\phi_n} + \frac{\phi_2}{\phi_n} + ... + \frac{\phi_{n-1}}{\phi_n} = \sum_1^n \frac{\phi_j}{\phi_n} = 0$</td></tr>
<tr><td colspan="2">Values φj and ϕj are homogeneous functions of the parameters of the elements of the system, and of the parameters of the processes, and in the general case, of their derivatives. In their turn, P_1 and R_1, P_2 and R_2, and,...,P_m and R_m are similar parameters, and, since the processes are similar, we can write: $\frac{P_1}{R_1} = m_1$; $\frac{P_2}{R_2} = m_2$; ... $\frac{P_m}{R_m} = m_m$ Substituting in expression φ_j, due to homogeneity, the scale factors $m_1, m_2, ..., m_m$ to the requisite powers, they can be taken out of the function's symbol. Thus: $P_1 = m_1 R_1$; $P_2 = m_2 R_2$; ... $P_m = m_m R_m$ and $\varphi_j = f(P_1, P_2, ..., P_m) = f(m_1 R_1, m_2 R_2, ..., m_m R_m)$ and $\varphi_j = N_j f(R_1, R_2, ..., R_m)$ and so $\varphi_j = N_j \phi_j$ and the equalities occurring: $\varphi_1 = N_1\phi_1$; $\varphi_2 = N_2\phi_2$; ... $\varphi_n = N_n\phi_n$.
Consequently: $1 + \frac{N_1}{N_n} \times \frac{\phi_1}{\phi_n} + \frac{N_2}{N_n} \times \frac{\phi_2}{\phi_n} + ... + \frac{N_{n-1}}{N_n} \times \frac{\phi_{n-1}}{\phi_n} = 0$
Since the equation that characterizes the process is homogeneous, the common factors Nj for each term φ_j are equal, namely $N_1 = N_2 = ... = N_n$ and $\frac{N_1}{N_n} = \frac{N_2}{N_n} = ... = \frac{N_{n-1}}{N_n} = 1$
The resulting relations are obtained $\frac{\varphi_1}{\varphi_n} = \frac{\phi_1}{\phi_n}$; $\frac{\varphi_2}{\varphi_n} = \frac{\phi_2}{\phi_n}$; ... $\frac{\varphi_{n-1}}{\varphi_n} = \frac{\phi_{n-1}}{\phi_n}$ and, through generalization, we have:
$$\frac{\varphi_j}{\varphi_n} = \text{idem}, \quad (3)$$
where idem means respectively identical for all the processes considered. Thus, in the similar processes some relations between the parameters, called criteria of similitude, are numerically identical. Some of those criteria are determining, that is to say they influence the possibility of similitude, and make it concrete (they contain the conditions of univocalness, the limit conditions, etc.). In the case of the complex phenomena, several different processes can take place simultaneously. The similitude of each of those processes, taken separately, will ensure the similitude of the whole phenomenon.</td></tr>
</table>

Physical similitude joins *complete similitude*, centred on *isomorphous modelling*, *and incomplete similitude*, based on *homomorphous modelling*, *approximate similitude*, linked with some simplifying premises. Economy and economic processes are transposed in other situations of similitude, seldom complete, and more often than not incomplete and approximate or partial (commercial similitude, similitude in products and services, the similitude of the economic activity being conducted, similitude in markets or in marketing, similitude in management, the similitude of small and medium-sized firms, etc). Forming the essence of the process of modelling and of the correspondence of the physical nature of similar phenomena, two types of similitude can be distinguished, the physical one (where the physical natures of the similar phenomena are identical, i.e. the mechanic, thermodynamic, etc. processes in the system under study correspond to the mechanic, thermodynamic, etc. processes in the systems similar to the former), and the mathematical one (the correspondence between the parameters of the processes being compared, for instance the identical form of the equations describing phenomena of a different physical nature). Similitude can be established for both the phenomena that are subject to a set of definite laws (for instance, similitude according to the laws of classical mechanics), and the phenomena that are subject to statistical laws (*the statistical similitude* of the macroscopic phenomena, established based on the similitude of micro processes). Certainly, physics multiplies the typology of similitude through its pragmatic and experimental character, from the one of a *dynamic type*, to the *thermo type*, and to *hydrodynamic, aerodynamic, electrodynamic*, etc. similitude. All the types of similitude mentioned above are subject to certain general laws, which are commonly called *theorems of similitude*, and represent the *theorems of the physical model of similitude*. There are three such theorems.

If the similitude criterion is noted by π, the first theorem for all the similar phenomena is:

$$\pi = \text{idem} \tag{4}$$

One has to mention that the reciprocal relation is also valid: *if the similitude criteria are numerically identical, the phenomena are similar*. A major importance is held by the following property of the criteria of similitude: *the criteria of similitude of any process can turn into criteria of a different form, obtained through operations of multiplication or division of the criteria previously determined*. If $\pi_k = \text{idem}$, and $\pi_{k+j} = \text{idem}$ are two indefinite criteria, it is evident that $\pi_k \times \pi_{k+j} = \text{idem}$ and $\pi_k / \pi_{k+j} = \text{idem}$ $1/\pi_k = \text{idem}$ and $k \times \pi_k = \text{idem}$, where k is an indefinite constant value. For a given research, the relationship described represents the *criterion of complete similitude*.

If, before determining the similitude criteria, equations (1) and (2) are simplified, for example through neglecting certain factors that influence the unfolding of the processes, then the criteria determined from these equations are called *criteria of approximate similitude*. Reverting to relations (1) and (2), it is presupposed that in equation (2) the term ϕ_1 is missing, so in that equation, after it is brought to a non-dimensional form, there is a criterion less than there is in equation (I). It is also presupposed that formally, through an appropriate choice of the variable scale factors, one gets $\frac{\varphi_1}{\varphi_n} + \frac{\varphi_j}{\varphi_n} = \frac{\phi_j}{\phi_n}$.

Thus, equation (1) and equation (2), transformed formally through introducing the variable scale factor, will be made up of similar terms, securing the similitude of the perception of the processes described by equation (2) with that of the processes described by equation (1). Sometimes, in that case the scale factors play the part of the criteria of similitude, since, by selecting the scale factor out of the conditions of the similitude, the phenomena are rendered similar. Choosing the variable scale factors to obtain a conventional similitude is not always possible, and besides such a method does not always conduce to practically useful results. Choosing the variable scale factors can be considered a non-linear transformation of the variables, which highlights the quasi-similitude of the phenomena. In the particular case of the complex phenomena, a number of different processes can unfold simultaneously. The similitude of each of those processes, taken separately, will ensure the similitude of the whole phenomenon. It has to be mentioned that the reciprocal situation is also valid: *if the similitude criteria are numerically identical, the phenomena are similar*. A special importance is held by the following property of the criteria of similitude: *the criteria of similitude of any process can turn into criteria of a different form, obtained through operations of multiplication or division of the criteria determined previously*.

The second theorem of similitude, also known by the name of theorem π, has the following enunciation: *any complete equation of a physical process, written in a certain system of units, can be represented in the form of a relation between the criteria of similitude, that is to say non-dimensional ratios made up of the parameters included by the equation*. The results obtained can be extended to any number of similar processes, which is why, the equation:

$$\pi_1 = \phi(\pi_2, \pi_3, ..., \pi_{m-k}), \qquad (5)$$

which represents the mathematical formulation of theorem π, is called *equation of criterion*. This indicates the fact that one of the $m - k$ criteria of similitude is a function of the other $m - k - 1$ criteria, which are independent. In the previous case, they are $\pi_2, \pi_3, ..., \pi_{m-k}$. In its turn, criterion π_1 is dependent on them, too; if the independent criteria are satisfied, it will be satisfied automatically.

The third theorem of similitude establishes the necessary and sufficient conditions for the phenomena to be similar. The conditions for the application of similitude are very diverse, and that is why the theorems of similitude will be examined in various variants. This third theorem is formulated as follows: *the necessary and sufficient conditions of similitude are the proportionality of the similar parameters that are included by the conditions of uniqueness, and the equality of the criteria of similitude of the phenomenon under study*. In keeping with π theorem, one of the m-k criteria is a function of the others, and is observed automatically when those are equal. Thus, it is obvious that the equality of the m-k-1 criteria is sufficient to ensure the possibility for the processes to be similar. That possibility is achieved when, after the uniqueness conditions have been given, *the concrete processes the similitude of which is to be ensured are separated from the infinite set of the processes* to which the differential equation given corresponds. This is the very condition that is contained in the third theorem of similitude. The values characterizing the uniqueness of the process are obligatorily included in the differential equation if it is complete. If that is taken into account, one can omit, in formulating the third theorem, the special mention of settling the uniqueness conditions, which is their proportionality. One can consider that the values that satisfy the uniqueness conditions also satisfy the conditions of proportionality, and their scale factor can be established in conformity with the equations previously determined.

In that case, the third theorem can also be formulated as: *the similitude of two given systems occurs in the case when all the similar values in those systems are proportional, and if* m-k-1 *criteria of similitude determined are equal, in accordance with* π *theorem, in the* *complete equation (or in the complete system of equations) of the physical process analysed.*

The study of the similitude of the phenomena in the complex, non-linear and non-homogeneous systems requires, besides the application of the three fundamental theorems of similitude, considering another four additional conditions. The four additional conditions concerning similitude are stated in the following manner:

- *the similitude of the complex systems that contain a number of subsystems separately similar is ensured through the equality of the similitude criteria made up of the parameters common to the similar subsystems*; the consequence is that the *similar complex systems remain similar after any simplifications if those simplifications were made in a similar manner in both systems;*

- *all the theorems and conditions of similitude valid for the linear systems can be extended to any non-linear systems, or systems of variable parameters if the following additional condition is observed: the coincidence of the relative characteristics corresponding to the variable or non-linear parameters*, i.e. the characteristics of the type: $P_{*n} = \varphi_{*0}(P_i)\ P_{*i}$, where the asterisked values represent the relative values, expressed in fractions of a certain characteristic parameter;

- *the conditions of similitude valid for the isotropic systems can be further extended to anisotropic systems if the anisotropy in the systems compared is relatively identical; the conditions of similitude valid for the homogeneous systems can be extended in either senses to the non-homogeneous systems too, if the non-homogeneity of the systems compared is relatively identical*;

- *the processes which take place in the systems that do not exhibit a geometric similitude, but are finally similar or have a given non-linear similitude of space, can be physically similar, having, in the similar points of the space, similar variations of the parameters of the process.*

The specific applications of the physical model of similitude, i.e. those concerning static or dynamic mechanical similitude, *thermo type, hydrodynamic, aerodynamic, electrodynamic, etc. similitude, become methods of knowing and projection in the case of the economic processes, or of the phenomena similar to those in mechanics, electricity, thermodynamics, etc.*

To simplify the practical comprehension of these modelling applications, an example from the study of materials resistance is resorted to. Any straight beam, on which various concentrated or continuous loads act, deforms, by bending. In the specialized courses of lectures and manuals, the demonstration goes that, in that situation and within the limits of elastic deformations, the line that unites the gravity centres of all the straight cross-sections of the deformed beam – called the neutral axis – is a continuous curve, having at any one of its points a curvature expressed through the relation:

$$1:\rho = M:(E \times I) \qquad (6)$$

where ρ is the curvature radius, E the elasticity module of the material the beam is made of, and M and I are the bending momentum, and the inertia momentum of the cross-section considered. Using this relation, the bars can be sized, whose models were previously tried through vibration tests. The bars that are submitted to compression by a force P are tested for vibration. We will notice that, if the length of the bar is great, a bend occurs and the bar resists a load much smaller than that established for compression. Then it is said that the bar vibrates, and that is why it can no longer be calculated simply in compression. Vibration is due to several causes, and load P can never be perfectly centric. We will have such bending momentums occurring at the deformation of the bar. The piece, in turn, can never be perfectly straight, and load P will have different eccentricities as to the different sections, which produce bending momentums. Similarly, the material cannot be perfectly homogeneous. The resistances, no longer uniformly situated, will determine a bending momentum. In all those cases, the bending momentum generated by the eccentricity of the force tends to increase the eccentricity, and so we have a case of unstable equilibrium. Because of that, the outer forces no longer find the opposition of the inner resistances, thus occurring inadmissible arrows in a building element, and then the structure can even break at its base. Formulas have been developed for calculating the vibrating pieces, but sometimes it is preferable, before going on to make the respective piece, to make tests on models, especially in the case when the cross-section of the pieces is more complicated, and one seeks to avoid unnecessary use of security coefficients, which could lead to over sizing the construction elements.

A revolving body, in the shape of a model bar, is subjected to a number of loading tests for centric vibration. Let P_1= 125 N the force for which the model can resist vibration. We note E1 for the elasticity module of the material that the model is made of. We have to determine the vibration force P_2 for the congruous geometric original having the linear size ten times larger, whose elasticity module E_2 is different from E_1 (we consider $E_2 = 2E_1$). It is presupposed that the type of support for the two bars is congruous from a geometric and elastic standpoint, and the critical vibration forces do not try the bars beyond the limit of elasticity. As a starting point, we use the equation (6), which gives the curvature of the two congruous elastic lines.

The original equation can be written $1:\rho_2=M_2:(E_2\times I_2)=(P_2\times y_2):(E_2\times I_2)$, and for the model $1:\rho_1=M_1:(E_1\times I_1)=(P_1\times y_1):(E_1\times I_1)$, where ρ_1 and ρ_2 are the curvature radii. M_1 and M_2 are the bending momentums, and I_1 and I_2 are the inertia momentums of the bar cross-sections (which are known to be proportional to the fourth power of one length). Dividing the two relations, the result is:

$$\frac{\frac{1}{\rho_2}}{\frac{1}{\rho_1}} = \frac{\frac{P_2 y_2}{E_2 I_2}}{\frac{P_1 y_1}{E_1 I_1}} = \frac{P_2 y_2}{P_1 y_1} \times \frac{E_1 I_1}{E_2 I_2}.$$

In keeping with the principle of similitude, from the model to the original, the lengths must pass to the ratio of geometric congruence, noted with A.The result is: $\frac{1}{A} = \frac{P_2}{P_1} A \times \frac{E_1}{E_2} \frac{1}{A^4}$.

Consequently, the vibration force P_2 is calculated by means of law: $P_2 = P_1 \times A^2 \frac{E_2}{E_1}$, and, replacing it with the numeric values given in the problem, the value of the vibration force P_2 is calculated for the main execution, and thus $P_2\,(N) = 125 \times 10^2 \times 2 = 25000$.

Now let us try to simply transpose the above model to economic matters; a company owns certain products, with definite elasticity coefficients (E), on a market situated in a given cyclical evolution, and placed within a given point of a curvature radius in the specific cycle of the business (ρ), a non-homogeneously distributed and non-authorized, relatively inertial in terms of dynamics, and easy to determine market (I), from one moment to another (ten days, month, year), and with a growing competition pressure known by the market demography (M). The dynamic models of viscosity and fluidity in mechanics can be analogously transposed, through similitude with the economic phenomena specific to the capital flows, the export–import flows, etc., or models of similitude of the thermo type, electrical or acoustic amplifiers, with phenomena in macroeconomics, such as economic growth, etc. In keeping with the previously presented theorems, the criteria of approximate similitude are established, which are necessary to start the modelling process. The physical model finds, again, there are *two main methods* to determine them. The first method lies in reducing the equations of the physical process to a non-dimensional form, and consequently, in order to use that method one has to know the differential equations of the process under research. The second method is based on the application of theorem π. That method can also be used in those cases when only the parameters that take part in the process being researched are known, while the equations of the process are not. In the practice of physical modelling, sometimes the *method of the relative units* is also used, which represents a variant of the two above methods. In that case, the parameters are expressed in fractions of the fundamental values selected in a given manner. The most important parameters, expressed in fractions of the fundamental values, can be considered as criteria of similitude valid under the given concrete conditions.

2. Some examples from the economic and social reality of the birth and existence of Serbian corporations, and also of corporate social responsibility (CSR)

Against the background of grouping or amalgamating similar SMEs, discussed in first part of the article, a number of clusters (in fact, corporations) have been developed in Serbia, mostly by SMEs connected through commercial relations, or sharing the same infrastructure, customers or skills base. This research has focused on determining certain characteristics of the 25 groups of enterprises (corporations) identified, presented in the following table. In the table, only the groups that receive aid from the Republic of Serbia are listed – yet a large number of other, especially informal, groups exist in the Serbian economy. The table presented below is however representative of formalized enterprise grouping (formal corporations) in Serbia, because other groups, *e.g.* ecology cluster *Helix*, available online http://www. heliks.org.rs, have a similar size and structure. For each cluster, the data was gathered by the analysis of formal reports of cluster (corporation), or from government reports. If none was available, individual financial and business reports for cluster members were analyzed where available, and synthesized as estimates. In several cases where such data was not available, the estimation was given based on industrial average in Serbia (the estimations being mentioned in the table). There are several enterprises among those clusters (national or multinational corporations), like *Zastava Automobili*, *Tigar*, *Trayal*, which are large enterprises, some employing several thousand people. The rest of the similar enterprises are mainly SMEs, with fewer than 10 employees. The average number of employees per enterprise in the sample is 32, and the average turnover per enterprise is €2.653.313, or €82,874 per employee. If we accept the classification of small, medium-sized and large enterprises, according to Serbian law that uses the average number of employees, total income, and assets value stated in financial report in the previous business year, we can accept the model of similitude abstraction to perceive those 25 groups as 25 aggregated enterprises (a SMEs reunion). Out of 25 groups presented in the table no. 2, which were perceived in that way, 23 can be classified as large enterprises (national or multinational corporations), and two as medium enterprises, although the companies comprising the groups are mostly small, or even micro-companies.

Table no. 2: Formal clusters and groups of enterprises (corporations), in Serbia

Group name	Purpose/Industry	Number of entities in the group	Total number of employees	Total turnover (€)	Type of similarity generating corporation	Contact/web site
Automobilski klaster Srbije	Automobile industry	35	800	350.000.000	Similarity in products or services	www.acserbia.org.rs
Srpski softverski klaster	Software industry	16	3000	800.000.000 (est.)	Similarity in products or services	www.ssc.rs
Bipom klaster	Agriculture machines industry	22	810	16.522.000	Similarity in products or services	www.bipom.org.rs
Šumadijski cvet	Flower production	109	544	2.106.500	Similarity in products or services	www.sumadijskicvet.com
Agencija za drvo	Wood manufacturing	141	5500	90.000.000	Similarity in the market (marketing)	www.agencijazadrvo.rs
Fond Kraljevski odmor	Tourism in Kraljevo region	26	2000	31.052.631	Similarity in location	www.kraljevskiodmor.com
Prvi klaster plastike i ambalaže - JATO	Packaging industry	13	317	1.097.222	Similarity in products or services	www.jato.org.rs
Klaster hotelijerstva i gastronomije Srbije	Tourism	26	2993	200.364.360	Similarity in products or services	www.hugos.rs
Fond turistički klaster mikroregije Subotica, Palić	Tourism	29	528	12.363.294	Similarity in location	www.subotica.info/privreda
Embedded.rs	Integrated electronic systems	12	130	10.000.000	Similarity in products or services	www.embedded.rs
Feniks	Aerial industry	18	730	14.996.588	Commercial similarity	www.phoenix-serbia.aero

Asstex	Textile industry	17	728	9.585.884	Similarity in products or services	info@asstex.org
Srpska filmska asocijacija	Movie industry	16	50	5.263.157	Similarity in the market (marketing)	www.filminserbia.com
Galenit	Collection and recycling of used batteries and accumulators	16	1200	350.000.000	Commercial similarity	www.galenit.org.rs/
Klaster Dundjer	Construction	59	1226	1.580.325	Similarity in the market (marketing)	www.dundjer.co.rs/
Klaster proizvođača obuće Knjaževac	Textiles and shoes	20	190	1.875.000	Commercial similarity	www.klasterobucara.com
Istar 21	Tourism	21	228	3.014.932	Similarity in the market (marketing)	www.istar21.com
MICE Klaster	Business, manifestation and MICE tourism	14	120	1.000.000	Similarity in the market (marketing)	bonvoyage@sbb.co.yu
Klaster medicinskog turizma	Medicine tourism	20 (est.)	400 (est.)	5.000.000 (est.)	Commercial similarity	www.medicinskituriza musrbiji.com/
Pekos	Pastry industry	23	200	3.500.000 (est.)	Commercial similarity	zandomns@eunet.yu
Turistički klaster Srem	Tourism in Srem region	23	250 (est.)	2.500.000 (est.)	Similarity in location	klasteri.merr.gov.rs/Svi
Ekokrug	Ecology	8	350	8.750.000	Transformed in similar situations	www.ekokrug.rs
Netwood	Furniture production	12	180	4.000.000 (est.)	Similarity in products or services	www.netwoodcluster.net
MEMOS	Metal industry	19	308	9.000.000	Similarity in products or services	www.klaster-memos.org
Alko klaster južne Srbije	Grapes, wines and spirits industries	16	622	6.000.000.	Commercial similarity	www.alcocluster.org

*Note * (est.) = estimated values*

3. Social complexity and impact – the fifth dimension of a modern multidimensional enterprise or an international corporation (MNE)

In the opinion of the authors of the present paper, there are four classical economic dimensions of a modern multidimensional enterprise or an international corporation (MNE): a) the geographical dimension, or spatial limits of the economic market, as geographical areas of land coverage; b) the financial dimension, or financial market as turnover and profit – in terms of financial power or market quota dimension; c) the employment dimension, or human resources dimension, and finally; d) the time (as a line), or age of a modern corporation – like a life-cycle for each corporation, from the birth to the growing up, and the death of that economic and social entity. Social complexity and impact of an enterprise means the fifth dimension of a modern economic entity, but it can be found especially in multinational enterprises or international corporations (MNEs).

The social complexity and impact of enterprise groups, networks or clusters (national or multinational corporations) can be clearly expressed by increase in CSR. Such groups, networks and clusters are the latest form of modern international corporation inter-organizational structure. As mentioned in the section of the paper elaborating the physical model of similitude for SMEs' reunion, the concept of similitude or similarity, immanent to sciences like physics and mathematics, has a major impact on the tendency of enterprises to group and form clusters or networks. First, we will describe the traits of such forms, and then explain the impact on CSR through the example of 25 networks in Serbia. The small and medium enterprises can be characterized by exceptional levels of external networking and inter-firm linkages (Bryson et al., 1993). The tendency of SMEs to group and form clusters and networks has been initially studied during the mid-1970s at the University of Uppsala, as part of a broader research program dealing primarily with the functioning of business markets (Håkansson and Snehota, 1989), resulting in several different publications (Mattsson, 1985; Ford, Håkansson and Johanson, 1986; Thorelli, 1986). It was observed that, due to the environments including a limited number of identifiable organizational entities, the organizations were driven towards constant exchange relationships, giving considerable influence, in the network organization, to each node of the network. The idea was widely popularized by the dynamic network form (Miles and Snow, 1986), characteristic of its vertical disaggregation, brokers, market mechanisms and full disclosure information systems. The tendency of SME grouping can be observed in countries with adequate collectivist business culture, like Japan, where four types of business groupings can be distinguished (Dana, 1998):

- *Keiretsu* – a diversified enterprise group;
- *Sanchi* – a grouping of small businesses in a similar line of business;
- *Kyodokumiai* – a co-operative of small businesses, and
- *Shita-uke gyosha* – the subcontract system.

At the other end of the spectrum, countries with individual business culture also have witnessed grouping of SMEs, with the prominent example of Great Britain, where business service firms are highly concentrated into clusters, with this clustering pattern being most pronounced in London (Bennett, et al., 1999).

The common characteristic of all clusters is that the relations among members increase their competitive advantage, with additional benefits such as:

- Productivity increase through access to specialized data, information, institutions, developed complementarities;
- Increased capacity for innovation, through diffusion of technologic knowledge and innovations;
- Increased ration of newly formed enterprises, through forming new companies from part of the existing company;
- More flexibility in reaction to market demands;
- Incentive to improve ICT adoption, related to different aspects of organization (Čudanov, et al. 2008; Čudanov, et al. 2010) as the means of inter- and intra-organization improvement;
- Combination of advantages of specialization, flexibility and small market scope of small enterprises with capacity of large enterprises or corporations (Dulanović and Jaško, 2009);
- Mutual training, marketing and promotion.

Corporate Social Responsibility in the mentioned groups of Serbian enterprises can be practiced directly, e.g. through the environment preservation activities of Helix corporation or Galenit cluster. In such a manner, the grouped enterprises have more available resources, contacts, information and knowledge, having better potential to solve the social problems. Tourism Sustainability Group, comprising 22 members, is a guarantee of equity in the correct distribution of benefits and costs between the promoters of this sector, the host populations and their areas (Minciu et al. 2010), thus improving sustainable development as a form of practicing corporative social responsibility. Rowley (1997) discusses better potential of enterprise network to perceive and satisfy demands of its stakeholders, therefore leading to larger potential for social responsibility.

Another influential school of thought gives maximization of value of shareholders as the principal form of CSR (Friedman, 1970; Jensen, 2002). If we analyze companies in the 25 clusters described, we can see that 731 enterprises, employing 23,404 employees have a turnover of €1,939,571,893, i.e. €82,874 per employee, or €2,653,313 per enterprise, significantly above the Serbian average of €58,405 per employee, or €804,532 per enterprise. So, the previously mentioned benefits for SMEs that can singularly increase their CSR through different means (Olaru et al., 2010) give synergetic benefits in the potential for CSR increase, too.

Conclusions

In as far as Serbia is concerned, as an area chosen to achieve the practical analysis of the birth and dynamics of MNEs as reunions of criterially similar SMEs, there is a doubtless confirmation of the fact that the physical model of the similitude of the SMEs in forming the MNEs is a reality. Based on the analysis of the example of 25-clustered enterprises in Serbia, the authors can prove that the process of grouping, predominantly among SMEs, has, by the existing theoretical scope, affected CSR at least threefold.

The first impact is that groups of enterprises or MNEs can be founded, directly aiming at performing socially responsible activities, cf. the example of Helix or Galenit cluster, which perform environment conservation activities with direct or (in the case of Helix cluster) indirect government support. So, the groups of enterprises can serve as an able tool performing socially responsible actions for third parties, such as large enterprise (national or multinational corporations), or the government.

The second impact is that groups of enterprises or MNEs have more resources, information, knowledge and contacts, and are more aware of the stakeholders needs, therefore increasing their potential to perform socially responsible actions.

The third impact is that, on the observed sample of the organizations grouped in 25 clusters (corporations), the turnover per employee and the turnover per company are significantly above the Serbian average, thus giving increased dynamics of economic performance, and superior potential for increased CSR through long-term shareholder value maximization, as noted by Friedman and Jensen.

The general conclusion that can be drawn from observing some groups of enterprises (corporations) in Serbia is that grouping SMEs, in keeping with any of the similitude criteria, gives them larger potential for CSR. Possible future research might focus on specific criteria of similitude, and perform a comparative analysis of its influence on CSR and other organizational issues.

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